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JPRS 81182

30 JUNE 1982

# Japan Report

No. 155

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## JAPAN REPORT

No. 155

### CONTENTS

#### ECONOMIC

Economic Cooperation, Energy Policy Examined (Akira Hiyoshi; FAINANSU, Mar 82) .....	1
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#### SCIENCE AND TECHNOLOGY

Biological Cell Fusion, Nuclear Transplantation Discussed (KAGAKU SHIMBUN, 5 Mar 82) .....	25
---	----

Briefs	
Rocket Development	35

## ECONOMIC

### ECONOMIC COOPERATION, ENERGY POLICY EXAMINED

Tokyo FAINANSU in Japanese Vol 17, No 12, Mar 82 pp 14-25

[Article by Akira Hiyoshi, an accounting official in the Accounting Bureau]

[Excerpts] Part I. Expansion of Economic Cooperation

#### Current Conditions of Japanese Economic Cooperation

1. Economic cooperation is generally considered to include both government and private cooperation. The value of Japan's actual economic cooperation in FY-80 was approximately \$6.8 billion (refer to Table 1).

Japan's economic cooperation, including private contributions, recorded a high of \$10.7 billion in FY-78. Since then, however, private export credits, direct investment, and some other items have declined by a large margin because of the economic slump, among other reasons. Actual economic cooperation in FY-80 was about 60 percent of that in FY-78.

2. On the other hand, official overseas development aid (ODA), which is most strongly sought by developing countries, shows a remarkable increase because of positive efforts by the Japanese Government.

In other words, Japan's actual ODA in FY-80 was \$3.3 billion, a 25-percent increase relative to the previous fiscal year. It ranks Japan fourth, following the United States, West Germany, and France, among the 17 participating countries in the OECD's Development Assistance Committee (DAC). Compared with FY-75, just 5 years earlier, the dollar value of Japan's ODA has increased by about three times (ODA of DAC members doubled on the average), and the Japanese share of all DAC aid has increased by 50 percent (8 percent in FY-75 and 12 percent in FY-80) (refer to Table 2).

3. Japan's ODA consists of approximately 70 percent bilateral aid, which includes both bilateral grants and loans, and approximately 30 percent for multinational aid, which is Japan's contribution to international organizations. Of bilateral grants, slightly less than 60 percent is untied financial cooperation and the rest, slightly over 40 percent, is in the form of technical cooperation. Most bilateral loans are yen credits provided by the Overseas Economic Cooperation Fund (refer to Table 3).

Table 1. Japan's Actual Economic Cooperation (net expenditures; unit: millions of dollars)

区 (1) 分	1979年 (2)		1980年 (2)	
	金3額	構成比	金3額	構成比
(5) 援助総額 (対GNP比)	7,555.6 (0.75)	100.0	6,765.9 (0.65)	100.0
I 政府開発援助 (ODA) (6) (対GNP比)	2,637.5 (0.26)	34.9	3,303.7 (0.32)	48.8
(7) 1. 二国間贈与	560.2	7.4	652.6	9.6
(8) {技術協力	241.9	3.2	277.8	4.1
(9) {無償資金協力	318.3	4.2	374.8	5.5
(10) 2. 二国間政府貸付	1,361.0	18.0	1,308.2	19.3
(11) 3. 国際機関への出資拠出等	716.3	9.5	1,342.9	19.8
(12) II その他政府資金協力 (OOF)	210.1	2.8	1,478.0	21.8
(13) 4. 輸出信用 (1年超)	△ 235.1	△ 3.1	822.9	12.2
(14) 5. 直接投資金融等	675.4	8.9	767.0	11.3
(15) 6. 国際機関に対する融資等	△ 230.2	△ 3.0	△ 111.9	△ 1.7
(16) III 民間ベース協力 (PF)	4,708.0	62.3	1,984.2	29.3
(17) 7. 輸出信用 (1年超)	642.5	8.5	73.7	1.1
(18) 8. 直接投資等 (証券投資, 対外貸付を含む)	3,405.8	44.9	1,566.3	23.1
(19) 9. 国際機関に対する融資等	640.7	8.5	317.8	4.7
(20) 10. 非営利団体による贈与	19.0	0.3	26.4	0.4
(21) 参考 {輸出信用計 (22) {直接投資等計 (23)	{ 407.5 { 14,081.2	{ 5.4 { 154.0	{ 896.6 { 2,333.3	{ 13.5 { 34.5

Note: 1. The "total export credits" referred to is a total of export credits (exceeding 1 year) of "other official financial cooperation" and "private cooperation." In the same manner, "total direct investment" is a total of direct investments of "other official financial cooperation" and "private cooperation."

2. Figures in each column do not necessarily equal the total due to rounding.

Source: DAC Materials

Key:	(12) Other official financial cooperation
(1) Classification	(13) Export credits (exceeding 1 year)
(2) Year	(14) Direct investments
(3) Amount	(15) Loans to international organizations
(4) Ratio	(16) Private cooperation (PF)
(5) Total amount of assistance (relative to GNP in ( )).	(17) Export credits (exceeding 1 year)
(6) Official development aid (ODA) (relative to GNP in ( )).	(18) Direct investments (including investments in securities and overseas loans)
(7) Bilateral grants	(19) Loans to international organizations
(8) Technical cooperation	(20) Grants by nonprofit organizations
(9) Untied financial cooperation	(21) Reference
(10) Bilateral government loans	(22) Total export credits
(11) Contributions to international organizations	(23) Total direct investment

Table 2. Official Development Aid of DAC Countries (actual expenditure)  
(unit: millions of dollars)

区(1)分	金(2)額		対1975 年比率 4(倍)	DAC中シェア (5) (%)		対GNP比(%) (6)	
	1975年3	1980年3		1975年3	1980年3	1975年3	1980年3
米(7)国	4,161	7,138	1.7	30.1	(28.8) 26.7	0.27	0.27
西(8)独	1,689	3,517	2.1	12.2	(14.2) 13.1	0.40	0.43
フ(9)ス	2,093	(2,085) 4,053	1.9	15.1	( 8.4) 15.1	0.62	(0.32) 0.62
日(10)本	1,148	3,304	2.9	8.3	(13.3) 12.3	0.23	0.32
英(11)国	904	1,781	2.0	6.5	( 7.2) 6.7	0.39	0.34
オ(12)ダ	608	1,577	2.6	4.4	( 6.3) 5.9	0.75	0.99
カ(13)ダ	880	1,036	1.2	6.4	( 4.2) 3.9	0.54	0.42
(14)その他(10か国)	2,363	4,370	1.8	17.0	(17.6) 16.3	0.41	0.38
合(15)計	13,846	(24,808) 26,776	1.9	100.0	(100.0) 100.0	0.36	(0.34) 0.37

Note: Figures in ( ) indicate the case of France when ODA given to overseas prefectures and territories is excluded.

Key:

- |                            |                            |
|----------------------------|----------------------------|
| (1) Country                | (9) France                 |
| (2) Amount in dollars      | (10) Japan                 |
| (3) Year                   | (11) England               |
| (4) Ratio relative to 1975 | (12) Holland               |
| (5) Share of DAC total     | (13) Canada                |
| (6) Ratio relative to GNP  | (14) Others (10 countries) |
| (7) United States          | (15) Total                 |
| (8) West Germany           |                            |

Table 3. Main Items of Japan's Official Development Aid

(unit: millions of dollars and percent)

区 (1) 分	1979年 (2)		1980年 (2)	
	金(3)額	伸4率	金(3)額	伸4率
1. 二 国 間 贈 与 (5)	(1,228億円) 560.2	(21.2) 46.1	(1,480億円) 652.6	(19.8) 16.5
(1) 無償資金協力 (6)	318.3	96.2	374.8	17.8
① 一般無償 (7)	262.5	90.8	326.3	24.3
② 食糧援助 (8)	21.4	52.9	12.8	△ 40.2
③ その他 (9)	34.4	3.5倍	35.7	3.8
(2) 技術協力 (10)	241.9	9.4	277.8	14.8
2. 二 国 間 政 府 貸 付 (11)	(2,983億円) 1,361.0	(51.6) 18.6	(2,966億円) 1,308.2	(39.6) △ 3.9
(1) 海外経済協力基金 (12)	1,354.4	31.2	1,193.8	△ 11.9
(うち円借款) (13)	(1,298.4)	(30.2)	(1,139.0)	(△ 12.3)
(2) 輸 銀 (14)	△ 103.2	—	△ 121.8	—
(3) その他 (15)	109.8	3.5倍	236.2	2.2倍
3. 国際機関への出資、拠出等 (16)	(1,570億円) 716.3	(27.2) 4.7	(3,045億円) 1,342.9	(40.6) 87.5
合 計 (17)	(5,781億円) 2,637.5	(100.0) 19.1	(7,491億円) 3,303.7	(100.0) 25.3

Note: Ratio relative to the total ODA is given in [ ].

## Key:

- |                                  |  |
|----------------------------------|--|
| (1) Classification               | (10) Technical cooperation   |
| (2) Year                         | (11) Bilateral government loans                                      |
| (3) Amount                       | (12) The Overseas Economic Cooperation Fund                          |
| (4) Rate of increase             | (13) Yen loans in ( )  |
| (5) Bilateral grants             | (14) Japan Export-Import Bank  |
| (6) Untied financial cooperation | (15) Others  |
| (7) General untied               | (16) Investments in and contributions to international organizations |
| (8) Food support                 | (17) Total   |
| (9) Others                       |  |

## Outline of the FY-82 Budget

### Economic Cooperation Expenses

1. In response to the various international conditions surrounding Japan, the economic cooperation expenses appropriated in the FY-82 general account budget come to 471.2 billion yen, a large 10.8-percent increase over the previous fiscal year.

Table 4 is an outline summary of these expenses. Brief explanations of the main items follow.

#### Bilateral Untied Aid

In response to developing countries' requests for aid to improve basic living standards, funds to assist both economic development and the augmentation of food production have been increased. Aid for economic development is primarily for low-income developing countries and is intended to assist in the areas concerning basic needs of human life such as water, health, medical care, and education. Aid to augment food production is also for low-income developing countries and is intended to assist in purchasing food, fertilizer, and agricultural machinery.

#### Bilateral Technical Cooperation

Technical cooperation is intended to promote the self-help efforts of developing countries through technical transfer. It also includes the goal of developing and improving technology in developing countries.

In regard to the International Cooperation agency, the primary organ charged with carrying out Japan's technical cooperation, the number of trainees to be received from overseas, the number of specialists to be sent overseas through the program to dispatch specialists, and the number of Youth Overseas Cooperation Corps members to be sent overseas have been increased. The allowances of participants also have been improved. Funds for the establishment of an ASEAN "manpower building" center, a concept that Prime Minister Suzuki announced during his visit to five ASEAN countries in the spring of 1981, and construction of an international center in Okinawa have been newly appropriated in the FY-82 budget.

In addition, the number of new foreign students the Japanese Government will sponsor in FY-82 has been increased to 1,100 (950 in FY-81). Their allowances also have been improved.

#### Contributions Allocated to International Organizations

Japan continues to provide appropriate aid to international organizations such as the United Nations.

The rate of increase is especially high, because, in addition to the budget increases of the international organizations, the official exchange rate has been changed (217 yen per dollar in FY-81 but 229 yen per dollar in FY-82).



Table 4. Outline of Economic Cooperation Expenditures in the FY-82 Budget  
(unit: millions of yen and percent)

区 (1) 分	所(2)管	356 年 度		4 57 年 度	
		金5額	伸率6	金5額	伸率6
1. 二国間無償援助 (7)		128,394	14.9	141,637	10.3
(8)うち経済開発等援助費	外 務 省	83,000	10.7	92,000	10.8
(9) 食糧増産等援助費	大 蔵 省	45,272	23.8	49,637	9.6
2. 二国間技術協力 (10)		79,768	11.8	86,491	8.4
(11)うち国際協力事業団交付金	外 務 省	61,011	11.8	66,079	8.3
(12) うち研修員受入		7,786	15.6	8,466	8.7
(13) 専 門 家 派 遣		7,385	10.1	7,991	8.2
(14) 開 発 調 査		11,542	12.2	12,308	6.6
(15) 保健医療協力		3,533	11.1	3,652	3.4
(16) 農 林 業 協 力		5,756	9.9	6,211	7.9
(17) 青年海外協力隊派遣		4,083	9.7	4,597	12.6
(18) 国費外国人留学生	文 部 省	3,746	19.9	4,450	18.8
(19) 技術協力推進経費	通商産業省	10,267	13.0	10,898	6.1
(20) 国際機関分担金拠出金等		76,138	8.2	86,945	14.2
(21)うち国連分担金	外 務 省	12,942	11.7	15,891	22.8
(22)国連開発計画拠出金	外 務 省	10,177	7.7	12,001	17.9
(23)国連人口活動基金拠出金	外 務 省	6,402	21.1	7,672	19.8
(24)国連難民高等弁務官計画拠出金	外 務 省	13,042	△ 3.6	12,939	△ 0.8
(25) 海外経済協力基金拠出金	大 蔵 省	133,000	9.0	147,000	10.5
(26) (同 事 業 規 模)		480,000	13.7	535,000	11.5
5. そ の 他 (27)		8,060	12.9	9,068	12.5
合 (28) 計		425,360	11.2	471,141	10.8

Key:

- (1) Classification
- (2) Jurisdiction
- (3) FY-81
- (4) FY-82
- (5) Amount in yen
- (6) Rate of increase
- (7) Bilateral untied aid
- (8) Including economic development aid expenditures
- (9) Including, augmentation of food production aid expenditures
- (10) Bilateral technical cooperation
- (11) Including grants to the International Cooperation Agency
- (12) Including reception of trainees
- (13) Dispatch of specialists
- (14) Development surveys
- (15) Health and medical care cooperation
- (16) Agriculture and forestry cooperation
- (17) Sending of Youth Overseas Cooperation Corps members

- (18) Japanese government-sponsored students
- (19) Technical cooperation promotion expenses
- (20) Contributions to international organizations
- (21) Including, contributions allocated to the United Nations
- (22) Contributions to the United Nations' Development Plan
- (23) Contributions to the United Nations' Population Activities Fund
- (24) Contributions to the United Nations' High Commissioner for Refugees Plan
- (25) Investment in the Overseas Economic Cooperation Fund
- (26) The scale of its projects
- (27) Others
- (28) Total
- (29) Ministry of Foreign Affairs
- (30) Ministry of Finance
- (31) Ministry of Education
- (32) MITI

## The Overseas Economic Cooperation Fund

The Overseas Economic Cooperation Fund provides developing countries with the funds needed for industrial development and economic stability. Its scale of investments and loans has been expanded to 500 billion yen in direct loans and 35 billion yen for general items, a total of 535 billion yen (an 11.5-percent increase relative to the previous fiscal year). To finance operations, the OECF will receive 147 billion yen appropriated from the general account, borrow 207.2 billion yen from the Trust Fund Bureau, raise 13 billion yen in government guaranteed bonds, and use 167.8 billion yen of its own money.

2. As mentioned previously, economic cooperation expenses as a whole have been increased by a large margin in the FY-82 budget. Funds for individual items of economic cooperation no longer needed or now judged inappropriate have been reduced in order to obtain people's understanding and a consensus concerning economic cooperation even though Japan is currently undergoing desperate financial reconstruction. Savings and rationalization in the allocation of funds are considered in each case.

In accordance with the report of the Provisional Administrative Research Committee, measures have been taken to improve evaluation methods in order to conduct economic cooperation effectively as well as properly.

### Official Development Assistance

1. As mentioned previously, due to an increase in economic cooperation expenses, the FY-82 general account budget related to ODA has been increased by 45.2 billion yen, 11.4 percent more than the previous year (refer to Table 5).

(Note) Economic cooperation expenses in the general account and expenses related to ODA are not exactly the same. Of economic cooperation expenses, contributions allocated to international organizations such as the United Nations are only partially counted as ODA-related expenses. There are also some expenses that are not listed among economic cooperation expenses but are counted as ODA-related expenses.

The rate of increase in ODA-related expenses is 11.4 percent, which coincides with the annual average rate of increase necessary to achieve the mid-term goal for future ODA. This rate of increase shows our best effort is being made to achieve the mid-term goal in spite of the current economic difficulties.

(Note) The mid-term goal for ODA is "to double the ODA-related expenses in the budgets of the latter 5 years of the 1970's in the first 5 years of the 1980's."

2. Internationally, ODA is a concept discussed on the basis of the actual record of a fiscal year. However, if we estimate FY-82's ODA expenses on the basis of ODA-related expenses as already defined, it amounts to 941.8 billion yen. Its ratio relative to GNP is 0.34 percent, which is slightly more than that of the previous fiscal year (refer to Table 5).

Table 5. Outline of FY-82 Official Development Aid

(unit: 100 million yen and percent)

区 (1) 分	(2) 事業費		(3) 一般会計	
	456 年度	57 年度	456 年度	57 年度
1. 贈 (6) 与	( 5.4) [ 51.3] 4,559	( 3.2) [ 49.9] 4,704	(14.5) 2,581	(12.0) 2,890
(7)① 二 国 間 贈 与	(16.5) 2,149	(12.0) 2,407	(16.6) 2,117	(11.4) 2,358
(8)① 経 済 開 発 等 援 助 費	830	920	830	920
(9)② 食 糧 増 産 等 援 助 費	453	496	453	496
(10)③ 技 術 協 力	865	991	833	942
(11)④ そ の 他	1	—	1	—
(12)② 国 際 機 関 出 資 ・ 拠 出	(△2.8) 2,410	(△4.7) 2,297	( 5.5) 464	(14.7) 532
(13)① 国 連 等 諸 機 関	414	469	414	469
(14)② 国 際 開 発 金 融 機 関	1,996	1,828	50	63
2. 借 (15) 款	( 6.2) [ 48.7] 4,329	( 8.9) [ 50.1] 4,714	( 9.8) 1,384	(10.3) 1,527
(16)① 海 外 経 済 協 力 基 金	4,352	4,818	1,330	1,470
(17)② 日 本 輸 入 出 銀 行	△ 227	△ 304	0	0
(18)③ そ の 他	204	200	54	57
3. 合 (19) 計	( 5.8) [100.0] 8,888	( 6.0) [100.0] 9,418	(12.8) 3,965	(11.4) 4,417
(20)G N P 比 (%)	0.336	0.340		
(21)G N P (兆 円)	264.8	277.2		

Note: The ratio relative to total ODA in [ ] and the rate of increase over the previous year in ( ).

## Key:

- |  |   |
|--|---|
| (1) Classification                               | (12) Investments and contributions to international organizations |
| (2) Project expenses                             | (13) Various organizations such as the United Nations             |
| (3) Including, from the general account          | (14) International development financing institutions             |
| (4) FY-81  | (15) Loans  |
| (5) FY-82  | (16) The Overseas Economic Cooperation Fund                       |
| (6) Grants                                       | (17) Japan Export-Import Bank                                     |
| (7) Bilateral grants                             | (18) Others   |
| (8) Economic development aid expenses            | (19) Total  |
| (9) Augmentation of food production aid expenses | (20) Relative to GNP  |
| (10) Technical cooperation                       | (21) GNP (unit in 1 trillion yen)                                 |
| (11) Others                                      |   |

The share of general account funds in ODA-related expenses is approximately 40 percent. The remaining portion is funded by Fiscal Investment and Loan money and government guaranteed bonds. In FY-82, increases in the capital of international development financing institutions is unlikely because of delay in payment by the United States and other factors. Japan's investment in such organizations also cannot help but decrease from the previous year. In spite of such conditions, ODA-related expenses can maintain a high-level in the FY-82 budget. The reason is that the ODA-related expenses have received an extremely high rate of increase in the general account.

#### Future Subjects

1. As mentioned in the previous section, Japan's economic cooperation has increased sharply in recent years in spite of the fact that it, and ODA in particular, is based on budgetary funds and Japan is currently in a difficult financial situation.

However, advanced Western countries are now inclined to "review foreign aid." The Reagan administration of the United States especially is reviewing America's entire multinational aid policy and is taking an extremely cautious attitude toward a new increase in the capital of international development financing institutions.

Assistance to developing countries cannot be carried out by Japan alone. Effectiveness is achieved only with the cooperation of all countries. Especially in the case of international development financing institutions, it is important to maintain the principle of fair burden sharing among participating nations. Moreover, multinational aid occupies almost 30 percent of Japan's ODA. Consequently, there is a concern that the negative U.S. attitude toward international organizations will affect the actual achievements of Japan's ODA program. A positive attitude on the part of all countries, especially the United States, is desirable.

2. On the other hand, in spite of the rapid increase in Japan's ODA, the DAC is hoping even greater increases. However, Japan's ODA has reached a level comparable to those of other advanced nations in terms of dollars. Therefore, our future efforts should focus not on the amount of dollars but on the effective administration of ODA so that Japanese assistance is of true help to developing countries in developing their economies and improving welfare.

To the view which evaluates ODA only in terms of its ratio relative to GNP, the following counterpoints can be offered: 1) Since ODA should be conducted in consideration of the geographical and historical backgrounds of the supporting country, is it appropriate to base comparisons only on the GNP measure? (In the case of France, if ODA given to overseas prefectures and territories is excluded, its ODA relative to GNP equals that of Japan.) 2) Concerning a nation's capability to provide support, isn't it necessary to take into consideration the quality of its stock of domestic social capital such as housing and national income per capita of the supporting country? 3) At any rate, ODA does not have to be proportionate to GNP. Isn't it inevitable that the larger a country's GNP is the smaller its ratio relative to GNP will become?

(Although U.S. GNP and ODA are the largest in the world, the U.S. ratio of ODA relative to GNP is smaller than that of Japan.)

3. Furthermore, economic cooperation assumes self-help efforts on the part of the partner countries and must support such efforts. As aid increases, it does not remain within the level necessary to maintain basic living standards in the partner country. Although the need for self-help efforts has been increasing, the response to this problem by developing countries is still not necessarily sufficient.

In regard to this point, the mid-term goal for ODA states in its preamble that "as a precondition to achievement of the mid-term goal, we expect partner countries to improve further conditions for receiving assistance so that we can effectively support their self-help efforts toward economic and social development."

4. Finally, because ODA is based on budgetary appropriations, it is important that economic cooperation be conducted effectively and strictly and with due consideration for its relation to our national interest in order to obtain a sufficient understanding and consensus from the people.

## Part II. Promotion of Energy Measures

### Structure of the Energy Budget

1. Since energy measures require promotion from the long- and middle-term viewpoint, the demand for funds is expected to be enormous. Therefore, funds must be acquired so that energy measures can be promoted comprehensively and systematically. For this purpose, general sources of revenue as well as specified sources of revenue and user taxes based on the principle that beneficiaries should pay are fully taken into account in formulating the energy measures budget.

2. First, energy-related expenses to which the principle that the beneficiaries should pay is hard to apply (in other words, expenses required for basic research and administration of general energy policies) are appropriated from the general sources of revenue in the general account. In addition, a portion of the petroleum tax revenue, which is a source of revenue for petroleum and petroleum substitute energy measures, is transferred to the Special Account for Coal and Petroleum and Petroleum Substitute Energy Measures (the Coal and Petroleum Special Account).

3. In the Coal Account of the Coal and Petroleum Special Account, coal measures are financed by the Crude Petroleum Customs Duty.

In the Petroleum and Petroleum Substitute Account of the Coal and Petroleum Special Account, petroleum measures such as exploration and development of oil and petroleum stockpiles, and measures for petroleum substitute energy for uses other than electric power generation are financed by petroleum tax revenue transferred from the general account and a part of Crude Petroleum Customs Duty.

4. In addition, electric power source siting measures in the Electric Power Source Siting Account of the Special Account for Promotion of Electric Power Source Development and various measures for electric power source development by means of petroleum substitute energy in the Electric Power Source Diversification Account of the same special account are financed by the Tax for Promotion of Electric Power Source Development.

#### Outline of the FY-82 Budget

Taking into account the previously mentioned energy conditions, 563.2 billion yen has been appropriated in the general account for energy measures expenses in the FY-82 budget. It is a big 13.2 percent increase over the previous fiscal year, as in the case of economic cooperation expenses. For total energy measures expenses, which include special accounts, 922.6 billion yen has been appropriated, which is a 6.5-percent increase over the previous year.

An outline summary is given in Table 7 (for special accounts, refer to Table 8). The main items are briefly explained hereafter.

Petroleum provides more than half of Japan's energy supply. This condition is likely to continue for a while. On the other hand, because the international situation involving oil is extremely uncertain, as one of our energy measures, first of all, it is important to secure a stable supply of petroleum.

From this viewpoint, of all the energy measures expenses in the FY-82 budget, the greatest emphasis has been placed on the petroleum measures. In the Petroleum and Petroleum Substitute Energy Account of the Coal and Petroleum Special Account, 353.5 billion yen has been appropriated for petroleum measures. It has received the highest increase--15.7 percent above last year.

#### Petroleum Development

Promotion of exploration and development of oil and natural gas resources in Japan and overseas can be considered measures to secure stable supplies of oil.

Therefore, the exploration-related loans and investments of the Japan Petroleum Development Corporation continue to be promoted in the FY-82 budget. For these projects, 107.8 billion yen has been appropriated, a 10 percent increase over the previous year. The scale of the projects involving loans and investments has been expanded to 140 billion yen (116 billion yen in the FY-81 budget). These funds are expected to advance oil development activities that Japanese have been conducting in the Middle East (Abu Dhabi and Qatar), China (Bohai), and Canada (the Arctic Ocean). However, considering present financial conditions, the 140-billion-yen-scale of the projects is the result of suppressing as far as possible the ever-expanding demand for funds that accompanies satisfactory progress of the exploration projects. Incidentally, crude oil imports from fields developed by Japanese interests was approximately 9 percent of total demand in FY-80.

Table 7. Outline of FY-82 Energy Measures Expenditures  
(unit: millions of yen and percent)

区 (1) 分	56年度		57年度	
	金額	伸率	金額	伸率
一般会計 (6)	497,489	17.3	563,195	13.2
(7) 原子力平和利用研究促進費	164,722	4.3	164,838	0.1
(8) 新エネルギー技術関係経費	6,918	△ 1.6	6,177	△ 10.7
(9) 省エネルギー "	2,911	△ 5.2	2,980	2.4
(10) 石油税財源石特繰入	318,000	26.2	385,000	21.1
(11) 国際原子力機関分担金等	2,085	12.8	2,176	4.4
その他 (12)	2,853	25.2	2,024	△ 29.1
特別会計 (13)	686,783	20.8	744,451	8.4
電源開発促進対策 (14)	171,873	20.5	184,226	7.2
電源立地勘定 (15)	69,463	16.0	71,932	3.5
電源多様化勘定 (16)	102,410	23.8	112,294	9.7
石炭並びに石油及び石油代替エネルギー対策 (17)	500,046	20.7	543,551	8.7
石炭勘定 (18)	138,745	6.0	136,250	△ 1.8
石油及び石油代替エネルギー勘定 (19)	361,301	27.5	407,301	12.7
石油対策 (20)	305,600	23.0	353,524	15.7
石油代替エネルギー対策 (21)	55,701	59.4	53,777	△ 3.4
国立学校 (22)	14,864	25.4	16,674	12.1
一般会計・特別会計純計 (23)	866,272	16.9	922,646	6.5

Key:

- |   |   |
|---|---|
| (1) Classification  | (11) Contributions allocated to International Atomic Energy Agency        |
| (2) FY-81   | (12) Others   |
| (3) FY-82   | (13) Special account  |
| (4) Amount in yen   | (14) Electric power source development promotion expenditures             |
| (5) Rate of increase  | (15) Electric power source siting account                                 |
| (6) General account   | (16) Electric power source diversification account                        |
| (7) Expenditures for the promotion of the study of the peaceful uses of nuclear power | (17) Coal measures and petroleum and petroleum substitute energy measures |
| (8) New energy technology-related expenditures  | (18) Coal account   |
| (9) Energy conservation technology-related expenditures                               | (19) Petroleum and petroleum substitute energy account                    |
| (10) Transfers of petroleum tax revenue to the Coal and Petroleum Special Account     | (20) Petroleum measures   |
|   | (21) Petroleum substitute energy measures                                 |
|   | (22) National schools   |
|   | (23) Net total of the general account and special accounts                |





[Continuation of Table 8]

[illegible]

Within Japan, the Japan Petroleum Development Corporation plans to proceed with basic surveys for domestic petroleum and natural gas resources (8.9 billion yen for primary geophysical investigations and primary drilling).

Development of technology related to petroleum development is also taken into consideration. Research and development on oil shale development technology (2 billion yen), which started in FY-81, and secondary and tertiary recovery technologies, which are expected to raise the recovery rate for crude oil by a large margin (500 million yen), are also to be promoted.

#### Petroleum Stockpiles

The case of unpredicted emergencies in which petroleum supplies are cut off must be provided for by stockpiling petroleum on a short-term basis. In Japan private oil companies maintain 90-day stockpiles and the Japan Petroleum Development Corporation maintains an official stockpile.

As a result, Japan's oil stockpiles at the end of last year were about 63 million kiloliters (101-day supply) in the private-sector stockpile and 11 million kiloliters (17-day supply) in the government's stockpile, for a total of approximately 74 million kiloliters (118-day supply).

The private-sector stockpile exceeds by far the 90-day supply which is the quantity designated in the Petroleum Stockpile Act. This reflects the current easing of the international oil supply.

Considering the facts that the average stockpile of countries participating in the International Energy Agency (IEA) was 161 days as of April 1981 and that Japan greatly depends on oil imports, however, this 118-day stockpile can never be sufficient.

Therefore, the government is trying to maintain the 90-day stockpile structure for the private sector. At the same time, it ultimately intends to increase its own stockpile to 30 million kiloliters. In order to achieve this goal, the government stockpiling bases are being constructed by the Japan Petroleum Development Corporation.

In FY-82, of the government stockpiling bases already under construction, those in Mutsuogawara District and Tomakomai East District are to be promoted. As for stockpiling bases in the planning stage, the start of construction is to be promoted in the Shiroshima District, Fukui Harbar District, Kamigoto District, and Akita District bases. In order to finance purchase of land for construction of stockpiling bases in these districts, 17.1 billion yen has been appropriated for the Japan Petroleum Development Corporation's stockpiling projects.

In accordance with the report of the Provisional Administrative Research Committee, base construction expenses of the stockpiling projects are to be financed by private sector funds starting in FY-82. Consequently, 116.2 billion yen for base construction will not be appropriated from the Coal and Petroleum Special Account but financed by commercial loans. As a result, the amount of petroleum tax revenue transferred from the general account to the Coal and Petroleum Special Account has been reduced.

As a temporary measure until the completion of the official stockpiling bases, official stockpiles are being stored in borrowed tankers and private tanks. In FY-82, 124.7 billion yen has been appropriated to increase official stockpiles by approximately 1.5 million kiloliters. (Incidentally, taking advantage of the easing of oil supplies internationally, official stockpiles are being increased by 3.5 million kiloliters.) As a result, official stockpiles at the end of FY-82 are expected to be about 12.5 million kiloliters (about 19-day supply).

Next, private petroleum companies are legally obliged to stockpile a 90-day supply. For the portion exceeding the stock necessary for normal operation (usually a 45-day supply) of a 90-day stockpile, the government loans the companies funds to purchase the oil and to build storage facilities. In order to supplement the interest payments on the loans, 32.6 billion yen has been appropriated.

The Oil Stockpile Act was revised in FY-81. The revised law requires private companies to establish a 50-day stockpile of LPG by FY-88 (a 20-day stockpile of LPG is required in FY-82). The assistance equivalent to the case of oil stockpiling projects is to be provided for LPG stockpiling projects too.

#### Intermediate Fraction Measures

While the quality of imported crude oil has been becoming heavier, the demand for petroleum products tends to be for medium or light grades. Assuring stable supplies of the petroleum products such as kerosene that are used in people's daily lives is currently the most important subject of petroleum policies. For this reason, budget appropriations have been made for intermediate fraction measures. These measures concern both the supply and demand aspects of lighter oil products such as the development of heavy oil cracking technology (5.2 billion yen), development of new fuel oils technology (3.9 billion yen), and development of technology to utilize residual heavy oils (3 billion yen).

(Note: The petroleum measures and petroleum substitute energy measures which are described next are financed by the Coal and Petroleum Special Account. Transfer from the general account to the Petroleum and Petroleum Substitute Energy Account in the Coal and Petroleum Special Account have been increased by 67 billion yen, a large increase of 21.1 percent over the previous year. This is due to a decrease in revenue from the Crude Petroleum Customs Duty, another source of revenue to finance petroleum and petroleum substitute energy measures. This account's expenditures have been increased by only 12.7 percent. Examining the reasons for the increase, expenditures for the petroleum substitute energy measures are down, while expenditures for petroleum measures are up. The main items receiving increases are loans and investments for exploration and the government stockpiling. These two items are special cases in that exploration projects are joint ventures with oil-producing countries, and that official stockpiles need to be increased systematically. Incidentally, the revenue from the petroleum

tax is expected to be 434 billion yen in FY-82. Of that, 385 billion yen is to be transferred to the Coal and Petroleum Special Account. The difference of 49 billion yen will remain in the general account to finance other expenditures.

#### Petroleum Substitute Energy Measures

Japan depends on oil for approximately 70 percent of its primary energy supply. Moreover, Japan depends on imports for almost all its oil requirements. This fact, along with the unstable international oil situation, defines the vulnerability of the Japanese energy supply structure.

Under these conditions, targets for petroleum substitute energy supplies were determined in November 1980 as specified in the Law Concerning Promotion of Development and Introduction of Petroleum Substitute Energy. The ratio of petroleum substitute energy such as nuclear power, coal, and LNG to the total energy supply should rise to about 50 percent by FY-90 (it was about 35 percent in FY-80).

Based on this target, 166.1 billion yen has been appropriated in the special accounts (the Petroleum Substitute Energy Account and the Electric Power Source Diversification Account) in the FY-82 budget in order to improve petroleum substitute energy measures. It is a 5.1-percent increase over the previous year. In addition, 171 billion yen has been appropriated for nuclear power and other new energy-related expenses in the general account (a 0.4 percent decrease from the previous year).

#### Petroleum Substitute Energy Measures in the Coal and Petroleum Special Account

In the Petroleum Substitute Energy Account of the Coal and Petroleum Special Account, in order to promote development and utilization of petroleum substitute energy as a primary energy, 53.8 billion yen has been appropriated for exploration and development of foreign coal, conversion of oil-using industrial facilities to the use of petroleum substitute energy, diffusion of solar systems, development of coal liquefaction and gasification technologies, and expenses related to local energy development and utilization measures (55.7 billion yen in FY-81).

#### Petroleum Substitute Energy Measures in the Special Account for Promotion of Electric Power Source Development

At present over 40 percent of Japan's electric power is generated from petroleum. In order to reduce future petroleum dependency, development and utilization of various alternative electric power sources must be promoted. For this purpose, 112.3 billion yen has been appropriated in the Electric Power Source Diversification Account of the Special Account for Promotion of Electric Power Source Development (102.4 billion yen in FY-81).

The main contents are aids to research and development of utilization technologies for petroleum substitute energy such as hydroelectric power, coal thermal energy, geothermal energy, solar energy, and nuclear power as electric power sources and the construction of power plants that use petroleum substitute energy. In addition, funds and aid are given to the Power Reactor and

Nuclear Fuel Development Corporation for construction of a prototype fast breeder reactor and development of technologies related to reprocessing of used nuclear fuel.

#### Petroleum Substitute Energy Measures in the General Account

Nuclear power will play an important role in our future energy supply. Development and utilization of nuclear power continues to be promoted. To promote study of peaceful uses of nuclear power, 164.8 billion yen has been appropriated in the general account (a 0.1 percent increase from the previous year).

As mentioned before, 68.1 billion yen has been appropriated for nuclear power-related expenses in the Electric Power Source Diversification Account of the Special Account for Promotion of Electric Power Source Development. Therefore, nuclear power-related expenses total 233 billion yen (a 4.6 percent increase over the previous year). An outline summary is given in Table 9.

Concerning new energies such as solar energy, geothermal energy, coal energy, and hydrogen energy, the so-called "Sunshine Plan" has been carried out since FY-74 for the purpose of securing future energy supplies through development of new forms of energies.

In the FY-82 budget, a total of 41.6 billion yen (6.2 billion yen in the general account, 19.2 billion yen in the Coal and Petroleum Special Account, and 16.2 billion yen in the Special Account for Promotion of Electric Power Source Development) has been appropriated for expenses related to the "Sunshine Plan" (a 23.7 percent increase over the previous year). The solar power generation, research and development of a brown coal liquefaction project in Australia, and a nationwide survey for geothermal resources are to be promoted (refer to Table 10).

#### Energy Conservation Measures

In order to insure a stable balance between energy supply and demand, it is necessary to promote development of energy conservation technologies as well as making efforts to reduce energy consumption in every area of industry and daily life.

For this reason, the so-called "Moonlight Plan" has been carried out since FY-78. In the FY-82 budget, a total of 9.5 billion yen (3 billion yen in the general account, 300 million yen in the Coal and Petroleum Special Account, and 6.1 billion yen in the Special Account for Promotion of Electric Power Source Development) has been appropriated for expenses related to the "Moonlight Plan" (a 3.6 percent increase from the previous year). In addition to the large-scale energy conservation technology research and development projects currently in progress, research and development of an all-purpose Sterling engine will be initiated (refer to Table 11).

Table 9. Outline of the Nuclear Power-Related Budget

(unit: millions of yen and percent)

(1) 事 項	56年度 2	57年度 3	(4) 57年度計画の主要項目
安全研究の推進 (5)	17,504	17,055	① 工学的安全研究 (17)
(6) 一般 会 計	14,342	15,432	② 環境放射能安全研究 (18)
(7) 特 別 会 計	3,161	1,623	③ 新型動力炉の安全研究 (19)
新型動力炉の開発 (8)	66,709	73,255	① 高速増殖炉の開発 (原型炉「もんじゅ」 の建設, 実験炉の運転) (20)
(6) 一般 会 計	43,242	48,995	② 新型転換炉の研究開発 (21)
(7) 特 別 会 計	23,467	24,260	
(9) 核燃料サイクルの確立	70,446	63,490	① ウラン資源海外調査探鉱 (22)
(6) 一般 会 計	41,238	27,265	② ウラン濃縮技術の研究開発 (23)
(7) 特 別 会 計	29,208	36,225	③ 再処理技術開発, 放射性廃棄物処理処分 技術開発 (24)
核融合の研究 (10)	36,320	41,795	① 臨界プラズマ試験装置 (JT-60) の建設 (25)
			② トリチウム取扱技術の研究開発 (26)
			③ 日米核融合協力 (27)
原子力船の研究開発 (11)	6,856	7,197	① 原子力船「むつ」の新定係港の整備 (28)
			② 改良船用炉の研究開発 (29)
多目的高温ガス炉の 研究開発 (12)	4,954	5,455	① 大型構造機器実証試験ループの建設 (30)
			② 実験炉の詳細設計 (31)
(13) 原子力発電所安全対策			① 安全審査・検査の安全行政 (32)
(7) 特 別 会 計	2,559	2,848	② 被ばく低減化対策 (33)
原子力発電技術開発 等の推進 (14) (7) 特 別 会 計	2,481	4,476	① 軽水炉改良技術確証試験等 (34)
			② 廃炉対策 (35)
			③ 原子力発電支援システムの開発 (36)
			④ 中小型軽水炉の開発利用の検討 (37)
(15) 基 礎 研 究	30,794	30,409	研究炉の運転経費 (38)
(6) 一般 会 計	30,566	30,085	
(7) 特 別 会 計	228	324	
合 (16) 計	(9.7) 222,665	(4.6) 232,971	
(6) 一般 会 計	164,722	164,838	
(7) 特 別 会 計	57,943	68,133	

- Note: 1. Items partially overlap.  
 2. The rates of increase from the previous year are indicated in ( ).  
 3. Items not divided into general account and special account expenditures are general account expenditures only.

[Key on next page]

[Key to Table 9]

- (1) Item
- (2) FY-81
- (3) FY-82
- (4) Main items in the FY-82 plan
- (5) Promotion of safety studies
- (6) General account
- (7) Special account
- (8) Development of new type power reactors
- (9) Establishment of a nuclear fuel cycle
- (10) Studies of nuclear fusion
- (11) Research and development of nuclear ships
- (12) Research and development of multipurpose high-temperature gas reactors
- (13) Nuclear power plant safety measures
- (14) Promotion of nuclear electric generation technology
- (15) Basic research
- (16) Total
- (17) Safety studies in terms of mechanical engineering
- (18) Safety studies on environmental radiation
- (19) Safety studies on new types of power reactors
- (20) Development of fast breeder (construction of the "Monju" prototype and operation of an experimental reactor)
- (21) Research and development of new type converters
- (22) Overseas surveys and exploration of uranium resources
- (23) Research and development of uranium enrichment technology
- (24) Development of reprocessing technology and development of radiation waste treatment and disposal technology
- (25) Construction of a critical plasma testing facility (JT-60)
- (26) Research and development of tritium handling technology
- (26) Japan-U.S. nuclear fusion cooperation
- (27) Maintenance of the new designated mooring port for the nuclear ship "Mutsu"
- (28) Research and development of a reactor for improved ships
- (29) Construction of a demonstration loop for large structural apparatus
- (30) Detailed design of an experimental reactor
- (31) Administration of safety regulations; safety examinations and inspections
- (32) Measures to reduce radiation exposure
- (33) Demonstration of improved technology for light water reactors
- (34) Abandoned reactor measures
- (35) Development of nuclear power electric generation support systems
- (36) Development of small- and medium-sized light water reactors and studies of their uses
- (37) Operating expenses for research-use reactors

Table 10. Outline of the Sunshine Plan-Related Budget

(unit: millions of yen and percent)

<u>Item</u>	<u>FY-81</u>	<u>FY-82</u>
Solar energy	7,962	8,711
Geothermal energy	9,223	9,492
Coal energy	13,514	20,637
Hydrogen energy	948	923
Comprehensive study	1,233	1,067
International cooperation projects	668	674
Other	111	132
	(17.5)	(23.7)
Total	33,659	41,636
General Account	6,932	6,222
Special Account	26,727	35,414

Note: The rate of increase from the previous year is given in ( ).

Table 11. Outline of the Moonlight Plan-Related Budget

(unit: millions of yen and percent)

<u>Item</u>	<u>FY-81</u>	<u>FY-82</u>
Research and development of large-scale energy conservation technologies	8,316	8,473
Magneto hydrodynamic (MHD) electric generation	624	592
High-efficiency gas turbines	5,920	6,035
New type battery electric power storage systems	646	858
Fuel battery electric generation technology	239	618
All-purpose Sterling engines	0	275
Recycled heat utilization technology systems	887	95
Subsidy for development of energy conservation technology	467	669
Other	380	348
	(17.8)	( 3.6)
Total	9,163	9,490
General account	2,956	3,025
Special account	6,207	6,466

Note: The rate of increase over the previous year is given in ( ).



## Electric Power Source Siting Measures

Moreover, since future demand for electric power is expected to increase, it is necessary to promote electric power source siting beginning with nuclear power plants in order to secure adequate electric power supplies.

However, in recent years actual electric power source siting has tended to be delayed because of difficulties in negotiations with local residents.

For this reason, various measures are taken in the FY-82 budget to promote additional industrial development in electric power source areas. The use of Grants for Electric Power Source Siting Promotional Measures has been expanded to industrial promotion facilities. Measures are taken to improve the financing system by allowing the use of Grants to Electric Power Exporting Prefectures to attract enterprises. In addition, public acceptance measures such as public relations activities have been improved further in order to promote people's understanding and cooperation for the siting of electric power sources. For these purposes, 71.9 billion yen, a 3.5 percent increase over the previous year, has been appropriated in the Electric Power Source Siting Account of the Special Account for Electric Power Source Development.

## Coal Measures

Concerning coal measures, domestic coal production continues to be maintained. Strengthening the financial base of the domestic coal mining industry, maintenance of mine safety, and mining pollution measures are all promoted. For these purposes, 136.3 billion yen, a 1.8 percent decrease from the previous year, has been appropriated in the Coal Account of the Coal and Petroleum Special Account.

The reason for the budget decrease is the Provisional Administrative Research Committee recommendation that "the coal mining industry should become self-supporting." Grants to increase coal output and grants for coking coal storage and sales promotion measures are abolished. In addition, funds required for loans administered by the New Energy Development Organization to modernize facilities are to be financed with commercial loans instead of by the government. Incidentally, if we add commercial loans by the New Energy Development Organization and the expenses for the primary survey of coal resources development in the Petroleum Substitute Energy Account, the actual scale of expenditures for coal measures is 145.1 billion yen, a 4.6 percent increase from the previous year.

The seven coal-related laws which expire in FY-81 such as "the Coal Mining Industry Special Account and the Petroleum and Petroleum Substitute Energy Special Account Act" and "the Temporary Measures for Rationalization of Coal Mining Industrial Act" are expected to be extended.

## Future Subjects

1. Energy measures should be carried out systematically from a long-term perspective. The funds required for these measures will be enormous. On the other hand, the benefits of energy measures are ultimately returned to the

users and consumers of energy. Therefore, the funds needed to finance these measures must be collected from users and consumers in accordance with the degree of benefit.

2. However, this kind of special financial resource system creates various problems from the standpoint of integrated and efficient financial management.

At present, expenses related to energy measures are mainly financed by special sources of revenue because of the characteristics of energy measures and the difficult financial condition. Considering the problems accompanying the special financial resource system mentioned above, it is necessary to rationalize expenditures and pay constant attention to keeping in harmony with the general financial situation in managing revenues from special sources.

In other words, the scale of energy measures expenditures should be determined not by revenues but on the basis of the true necessity and urgency of the measures and with regard for a balance relative to other measures.

3. From this standpoint, energy measures should not be carried out across the board hereafter, but they need to be conducted efficiently with consideration for the following points.

First of all, energy measures involve the security of the country's petroleum supply and utilization of LNG and alternative forms of energy such as nuclear power in the short term, establishment of methods to utilize new forms of energy such as coal liquefaction in the mid-term, and development of nuclear fusion in the long-term. Therefore, it is necessary to carry out energy measures systematically and on a thoroughly realistic basis. Next, as for development of technologies related to petroleum and petroleum substitutes, the government should conduct research which the private sector could conduct only with difficulty. Even in such cases, it is necessary to determine the priority and contents of each development project and to examine strictly the required cost, the effect on energy supplies, the probability of successful completion, and furthermore, possible nonfinancial obstacles facing each kind of energy and its developmental process.

In order to do so, the market mechanism and the managerial judgment of the private sector must be utilized as much as possible. It is feasible to introduce a system that activates an automatic adjustment mechanism by asking the private sector to share the research and development burden and increasing the private sector's degree of burden sharing in accordance with the progress of a technology's development.

Alternative energy should be introduced primarily through the voluntary efforts of the private sector. Even in cases when some incentives are necessary, it is appropriate, as stated in the report of the Provisional Administrative Research Committee, to utilize the market mechanism and to limit incentives to those of a financing kind.

4. Concerning concrete measures, the following items need to be examined at present.

First, concerning loans and investments for exploration in the petroleum supply measures, the cost of self-development and the balance of oil supply and demand must be weighed as stated in the report of Provisional Administrative Research Committee and strict selections must be made so that truly promising projects can be financed. At the same time, even when managing joint projects with oil-producing countries, the progress of the projects must be in accordance with our financial situation. In the case of joint projects further adjustments can be expected by asking the private sector to assume an appropriate share of the risk burden.

Second, concerning development of oil-related and oil substitute-related technologies, exploring the likelihood of development of various technologies necessitates the execution of many development projects simultaneously and coverage of rather wide areas in the initial stage of development. As projects progress, however, it is necessary to nail down the most promising ones by strictly evaluating the results and flexibly selecting the projects. Certain projects for development seem to have reached the stage at which such examinations should begin.

5. Finally, at any rate energy problems accompany uncertainty. Therefore, it is most important for the promotion of energy policies that people have a common recognition of the importance of energy problems.

Consequently, in order to promote energy policies smoothly in the future, financial measures such as grants to plant sites may still be necessary, as typically seen in the case of nuclear power plant siting. However, advancing public relations measures to increase the public's correct understanding of energy issues seems to have become more important.

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CSO: 4105/103

## SCIENCE AND TECHNOLOGY

### BIOLOGICAL CELL FUSION, NUCLEAR TRANSPLANTATION DISCUSSED

Tokyo KAGAKU SHIMBUN in Japanese 5 Mar 82 p 5

[Text] Development of New Biological Resources by Cell Fusion and Nuclear Transplantation

The Ministry of Agriculture, Forestry and Fisheries (MAFF) will carry out "development of new biological resources by cell fusion and nuclear transplantation" with a research and development fund totalling approximately 1 billion yen under a 5-year plan beginning in FY-82. This large-scale project consists of three topics: "development of cell fusion application techniques for breeding crop plants, algae, and fungi," "development of cell line functional modification techniques by cell fusion," and "development of animal cloning and breeding techniques by nuclear transplantation." The work will be carried out by the 12 experimental research organs under the jurisdiction of the Agriculture, Forestry and Fisheries Research Council of the MAFF, national universities, and private firms in a collaborative effort of government, academia, and industry. The major goals of this project are: 1) to create agricultural crops having superior characteristics such as cold resistance, insect resistance, etc, by cell fusion of closely related species; 2) to enable the mass production of livestock antibodies and high purity vaccines by using the cell fusion technique; 3) to endow the homing ability to fish or to create a superior cocoon by exchanging the nucleus of an ovum with the nucleus of a cell from fish and insects; and 4) to enable cloning and mass production of superior strains by exchanging the nucleus of an ovum of livestock with the nucleus of other cells. As explained, the achievements of this project are expected to bring about increased production of agricultural crops, livestock, and prime fish and will become the foundation for solving the food problem facing the 21st century.

## Cell Fusion

### Protoplast Preparation First

The breeding of agricultural crops or livestock has been practiced since early days by mating. And, in recent years, research and development in breeding have been carried out by using chemical substances, radiation, cell fusion, etc. Cell fusion is a totally different technique from mating or the use of chemical substances, irradiation with radioactive rays, etc. Its main purpose is to strive for increased production of food, etc by fusing cells of different living organisms to endow cold resistance, insect resistance, humidity resistance, etc to agricultural crops, to create superior milk cows, and to endow a thermophilic character of homing ability to fish.

Efforts will be made to increase production naturally by providing agricultural crops and forest trees with cold resistance, insect resistance, humidity resistance, etc. At the same time, if greenhouse heat becomes unnecessary due to improved cold resistance, it will also result in energy-saving; insect resistance will make agricultural chemicals unnecessary whereby both resource-conservation and energy-saving result. Thus, it will be killing two birds with one stone, resulting in increased food production and resource- and energy-conservation.

In order to perform cell fusion of plants or microorganisms, the thick cell wall of a cell must be dissolved first with a special enzyme to prepare a "protoplast," a cell enveloped only in a thin cell membrane.

Cell fusion was successfully performed for the first time in the world by Professor Y. Okada of the Research Institute for Microbial Diseases of Osaka University. About 25 years ago, he succeeded in a cell fusion experiment by fusing human cells mediated by Sendai virus. Also, protoplast was prepared for the first time in the world at the Institute for Plant Virus Research of MAFF. Thus, Japan possesses a forerunner base for cell fusion.

### Induce Division and Redifferentiation

MAFF has succeeded in developing "hakuran," a hybrid between celery lettuce and cabbage. And, 4 years ago, Dr Melchers of the Max Planck Institute in West Germany produced a hybrid "pomato" from tomato and potato. However, it is still an intermediate product that does not bear seeds. The purpose of developing the pomato is an attempt to increase tomato production in cold regions by introducing the potato's cold resistant character into the tomato; the idea is not to harvest both tomatoes and potatoes simultaneously.

Cell fusion is meaningless unless the initially fused protoplast divides and multiplies.

Cell multiplication is carried out until it reaches a cellular mass called "callus." The next barrier is to skillfully redifferentiate the plant body from the callus stage (by hormone injection, etc).

Then, the next step is to produce fertile seeds (germinating seeds). In this research and development, a technique such as heterosis being used in the United States for corn, is not used.

Regarding the "development of cell fusion application techniques for breeding crop plants, algae, and fungi," the plan is: 1) to improve the techniques for preparing and fusing protoplasts, and 2) to develop a breeding technique by cell fusion.

Research has been conducted in the past regarding the technique to prepare plant or fungal protoplasts. However, in order to improve the preparation technique for protoplasts that are more suitable for fusion, plants as well as kinds of enzymes used in the preparation of protoplasts, operating conditions, and cultivating conditions are to be reevaluated. In addition, conditions for fusion, cultivating conditions for fused cells, and chemicals such as hormones to be added will be studied in order to obtain basic knowledge regarding the preparation of protoplasts and improvement in the fusion technique.

This research and development will be conducted by the Institute for Plant Virus Research and the National Food Research Institute of MAFF, and part of it will be commissioned to the Faculty of Fisheries at Kagoshima University. Private firms are participating in this project generally in the form of collaborative research.

#### Development of Cell Fusion Breeding Technique

"Development of a breeding technique by cell fusion" has the following characteristics: in the case of conventional breeding by mating, useful characters could not be introduced from a species that cannot be interbred. However, in cell fusion, as in the case of gene splicing, useful genes can be introduced into a species from another with which it cannot mate. Even in the case of fusion of species that do not interbreed, the latitude of mutation is extended by diploid or heteroploid formation of the chromosomes, and the function of useful genes can be enhanced. Therefore, the basic technique related to the application of cell fusion to breeding will be developed, while new breeding materials will be grown. In some crops, a new variety or new lines will be formed.

The target plants in this research include seed propagation plants (major crops, vegetables), vegetative propagation plants (potatoes, flowers, fruits, special use crops, trees), and fungi and algae (edible fungi, algae).

As for the technical development for a stable supply of "major crops," priority research has been conducted all along. With respect to the application of the new technology, basic research has been advanced such as the breeding of rice plants by another culture (tips of spikes are dipped in nutrient solution for cultivation) and the production of individuals from protoplasts of various crops such as rice plants and soy beans. Having these techniques to stand on, this research is attempting to produce new breeding material by cell fusion of the rice plants, soy beans, etc, among the crop species or with related species to introduce genetic characters such as humidity resistance, cold resistance, heat resistance, insect resistance, etc. The research will be conducted by the National Institute of Agricultural Science.

## Interspecific and Intergeneric Hybrids

The breeding of "vegetables" is basically done by mating. However, because no embryo develops in the case of interspecific crossing, a new technique was developed to perform embryonic tissue culture and hakuran (hybrid between celery lettuce and cabbage) was bred, thus responding to versatile social needs. In this research, cell fusion will be performed with Brassicaceae vegetables to develop a technique for producing interspecific and intergeneric hybrids.

In other words, the hybridization of radish and cabbage is targeted for the production of a new crop; and a production of fused individuals will be attempted by combining kale, brown mustard, radish, cabbage, eggplant, etc, in an effort to accumulate the insect-resistant genes possessed by each vegetable species and to produce the quality satisfying market demand. The research will be conducted mainly by the Vegetables Research Station of MAFF, and the basic research will be conducted at the Faculty of Sciences of Hokkaido University and the Agricultural Research Laboratory of Tohoku University. Research on Agricultural Research Laboratory of Tohoku University. Research on Solanaceae will be commissioned to the Central Research Laboratory of the Monopoly Corporation.

Among the tuber crops, cross-breeding has been practiced with sweet potatoes and white potatoes in the region where the plant flowers bear seeds. In the case of taro and yam, since perfect flowers cannot be obtained and no seeds are produced, breeding has been practiced by selection of variant individuals. In this research, fusion will be attempted first between varieties and strains and new crop plants and to develop new breeding techniques. The target for the yam is to obtain a new strain. The research will be conducted at the National Institute of Agricultural Sciences of MAFF, the Hokkaido Agricultural Experimental Station, and the Vegetables Research Station. Among the flowers, chrysanthemum demonstrates either a higher order polyploidy or heteroploidy in the number of chromosomes, fertile seeds cannot be obtained, and many of them cannot be bred by mating. In this research, cell fusions will be carried out between varieties, closely related species, and instantly related species in an attempt to obtain versatile color, shape, cultivation adaptability, etc, and to produce new lines. The research will be conducted at the Vegetables Research Station.

## Aiming at Expanded Adaptability of Trees

It used to be difficult to separate the protoplast of perennial crop plants such as "fruit trees." However, in recent years, this has been successfully accomplished with citrus fruits, apples, pears, etc. In this research, the goal is to establish a technique for preparing protoplasts of citrus fruits, apples, pears, peaches, etc, to perform cell fusion between the varieties and closely related species in order to elucidate chromosomal behavior associated with individual differentiation and to produce fused individuals. The research will be conducted mainly by the Fruit Research Station of MAFF.

Among the "special use crop plants," the protoplast of the mulberry tree was separated, but an individual has not been produced. In this research, an attempt will be made to study a cell fusion technique between the varieties and closely related species to produce individuals by cell fusion. The research will be conducted by the Sericultural Experiment Station of MAFF.

Among the trees, individuals were regenerated from protoplasts in eight varieties of genus *Populus*: silver poplar, Japanese aspen, Japanese poplar, common cottonwood, etc. The genus *Populus* includes species that are difficult to root from cuttings and those that are easily rooted, those suited for upland areas and those suited for fertile land. In this research, efforts will be made to establish a regeneration and differentiation technique of individuals from fused cells obtained by combining the above species and to obtain hybrid plants for expanded adaptability. The research will be conducted by the Forestry Experiment Station of MAFF using mainly poplars for pulp material.

#### Algae Centered on Laver

Currently, biochemical studies of "edible fungi" are being done at the cellular level. By applying this technique, an attempt will be made to prepare protoplasts for cell fusions of *Cortinellus*, *Pleurotus*, *Coprinus*, *Armillaria*, *Collybia*, etc., to produce edible fungi with high productivity or with new flavors. The research will be conducted by dividing the work between the Forestry Experiment Station and the National Food Research Institute of MAFF.

Among the "algae," the production of individuals from protoplasts has already been successfully accomplished in some edible algae. In this research, a technique for producing new lines by cell fusion will be developed centered on *Porphyra*. The research will be conducted mainly by the Tokai Regional Fisheries Research Laboratory of MAFF. Research on the algae of cold regions such as *Laminaria* will be commissioned to the Faculty of Sciences, Hokkaido University; and research and development of an enzyme suitable for preparing protoplasts, to the Faculty of Fisheries of Kagoshima University.

Overall research will be conducted on these projects at the Institute for Plant Virus Research, where a protoplast was prepared for the first time in the world.

The goals to be achieved through these research and development projects are to obtain hybrids between closely related species as new breeding material for major crop plants, vegetables, flowers, fruits, edible fungi, trees, etc., and to grow from these materials crop plant varieties having new characteristics in the future.

#### Specific Antibodies and Vaccines

In the "development of cell line functional modification techniques by cell fusion," research will be carried out in four categories: 1) development of monoclonal antibody production techniques, 2) technical development for production of highly virus-sensitive cell lines, 3) development of a genetic analysis technique by cell fusion, and 4) development of a technique to improve cell lines for pearl formation.

The "development of monoclonal antibody production techniques" involves establishment of a technique to prepare monoclonal antibodies against swine influenza virus with extensive mutations and those for mammalian type *Mycobacterium tuberculosis*, avian type *M. tuberculosis*, and *M. paratuberculosis* which overlap serologically and are difficult to diagnose.



## Test Tube Vaccines

It is due to lymphocytes that antibodies are produced in animals infected by virus or bacteria. But lymphocytes cannot be cultured. However, it has been proven by research thus far that it is possible to produce an antibody-producing line that can be cultured by cell fusion of cultured cells originating from a myeloma and lymphocytes.

When cultured cells having the properties of lymphocytes are produced using this technique, it becomes possible to make vaccines in a test tube.

Individual lymphocytes separately produce many kinds of antibodies, A, B, C, D and E, which make up an antiserum as a whole. One antibody-producing cell produces only one kind of antibody. Therefore, by isolating individual cultivatable antibody-producing cells obtained by cell fusion and separately multiplying them, each cell line will produce one kind of antibody (monoclonal antibody), and each monoclonal antibody can be produced in a large quantity.

When, among those monoclonal antibodies produced in this manner, one with a high specificity to an antigen is selected, a highly precise diagnostic antibody or prophylactic antibody can be obtained. Furthermore, the antigen can be refined to a higher purity by using the principle of absorption and dissociation.

In other words, the antibody-producing cells formed by cell fusion and having the properties of lymphocytes produce various kinds of antibodies, A, B, C, D and E. If, for example, only antibody C that specifically reacts to influenza is individually taken out among those antibodies under a microscope and collected, an antiserum having a very high precision to react only to influenza can be produced, which enables the development of a vaccine for swine influenza, etc.

It is also applicable to tubercle bacilli. Tubercle bacilli include mammalian type *Mycobacterium tuberculosis*, avian type *M. tuberculosis*, and *M. paratuberculosis*, and they could not be distinguished with the conventional diagnostic antisera. However, when a monoclonal antibody is used, they can all be distinguished. Thus, in the case of avian tubercle bacillus, caution is indicated against birds, and the increased diagnostic precision will lead to preventive measures.

In these studies, the goal is to obtain some prospect for practical application in a 5-year plan beginning in FY-82.

The research will be conducted by the National Institute of Animal Health of MAFF.

## Virus Replication Mechanism Pursued

In the project "technical development for production of highly virus-sensitive cell lines," attempts will be made to produce cell lines for culturing the bovine leukemia virus, swine enterovirus, and rice dwarf disease virus by fusion

and to develop a technique to replicate virus in large quantities with these tissue culture cells to be used for vaccine production and analysis of the virus replication mechanism. Or, cell lines for culturing cytoplasmic nuclear polyhedral disease virus of insects, ellipsoids of spleen disease virus and poxvirus will be produced by fusion, and a foundation for using the natural enemy, virus, will be built.

In order to culture virus in pure form, it is necessary to use tissue culture cells. Depending on the animal tissue of origin, some animal cells can be cultured whereas others cannot. On the other hand, the degree of viral replication (sensitivity) varies greatly by the type of tissue culture cells (tissue type of origin).

Consequently, it is possible to obtain a cell line that is highly sensitive to virus and readily cultivatable by fusing a readily cultivatable cell line with a tissue cell having a high sensitivity to virus. As a result, viral replication in tissue culture cells becomes easy, and pure culture becomes possible in large quantities.

The research will be shared by the National Institute of Agricultural Sciences, the Fruit Research Station, the National Institute of Animal Health, the Institute for Plant Virus Research, and the Forestry Experiment Station of MAFF.

#### Uniform Good-Quality Pearls a Goal

In the project "development of a technique to improve cell lines for pearl formation," the plan is to improve the culture line of pearl-forming tissue (mantle tissue) and at the same time to develop a technique to form a single cell by using enzymes, to produce by cell fusion a strain that has good quality and is readily cultivatable, and to develop a technique to have the cells from the tissue again. By using this tissue, it would become possible to obtain uniform pearls with good quality luster and color.

Pearls are made by inserting a core into a pearl oyster. If the color of the pearl oyster is yellow, a yellow, poor-quality pearl is produced. Therefore, in order to have the yellow pearl oyster produce a good-quality pearl, a piece of mantle tissue of a lustrous, good-quality pearl is now being inserted into the pearl oyster along with the core, and lustrous, good-quality pearls are being obtained.

As explained, qualities such as luster, color, etc of the pearls formed vary with the individual pearl oyster. However, when the core is enclosed in pearl forming tissue and inserted into the oyster, that pearl forming tissue forms a good-quality pearl. Therefore, an attempt will be made to develop a pearl-forming cell line by cell fusion that produces even better quality pearls.

The research will be conducted by the Cultured Pearl Research Institute of MAFF.

The goals to be achieved through these research and development projects are to develop new cell lines that enable mass production of antibodies with strong specificity, mass production of high purity vaccines, and the production of good quality pearls.

## Nuclear Transplantation

### Mass production of milk cow clones

The "development of animal cloning and breeding techniques by nuclear transplantation" includes: 1) development of a cloning technique for superior livestock lines, and 2) development of a breeding technique for oviparous animals by nuclear transplantation.

The "development of a cloning technique for superior livestock lines" will be for producing animal clones.

For the artificial pregnancy of livestock, research has been advanced in the past concerning the techniques for collecting, preserving, and transplanting a zygote into the uterus. In particular, artificial pregnancy using cultured zygotes is now undergoing application trials. In this research, attempts will be made to develop a technique to acquire ova in large quantities and to establish a technique to generate an individual from an isolated cell of an early embryo, as well as to advance research on external fertilization and parthenogenesis techniques and to develop a nuclear transplantation technique for zygotes and parthenogenetic ova to produce animal clones.

By doing so, the preservation and mass cloning of superior livestock become possible.

For example, in order to produce clones of the Holstein milk cow, a zygote is removed from the uterus of any cow, the nucleus of the zygote is discarded and replaced with the nucleus from a somatic cell of a Holstein, and the zygote is returned to the uterus to produce clones. Thus, by propagating copies of cows that are especially productive among the Holsteins, productivity can be drastically upgraded and superior lines can be preserved.

The research is conducted by the National Institute of Animal Health.

In Russia, an experiment is being conducted by using this method to produce a mammoth by inserting the nucleus of a mammoth into the ova of an Indian elephant. When a mammoth is discovered in the ice, the nucleus of the somatic cell is removed and inserted into the ova of an Indian elephant. In this case, successful results cannot be obtained unless the mammoth cells are young, and it is conjectured that they are probably using somatic cells of a fetal mammoth.

They failed in their first attempt; however, there is the possibility for the birth of a mammoth clone if the genes in the nucleus are viable even if the cell is dead.

### Applied to Unmatable Species

The "development of a breeding technique for oviparous animals by nuclear transplantation" is an R&D project to produce new species by nuclear transplantation of species that cannot be mated.

Since animal cells are differentiated into various organs and tissues, it is impossible to produce an individual from these cells. However, by removing the chorions of fish and insects to extract their nuclei and by transplanting nuclei from other cells, individuals can be obtained from the transplanted nuclei.

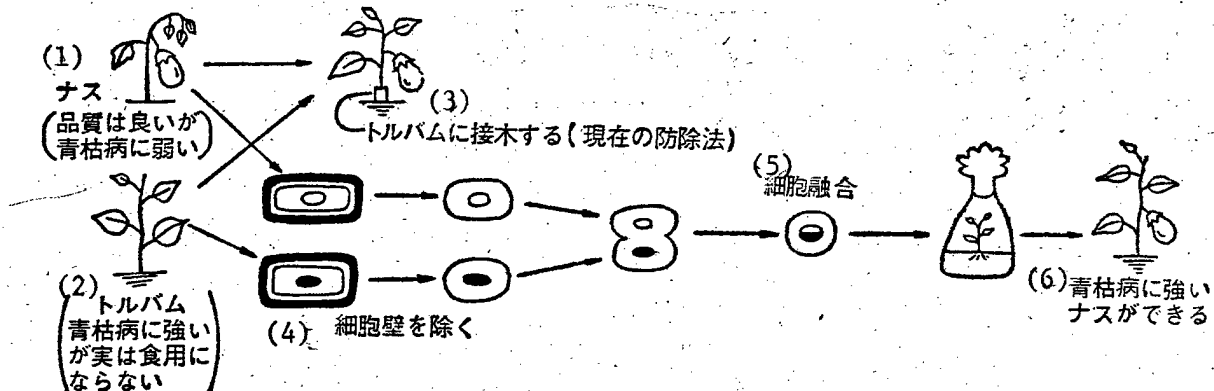
In this research project, ova of loach, rainbow trout, silkworm, etc, will be used to develop a nuclear transplantation technique for ova with a goal of breeding fishes and insects. Furthermore, an attempt will be made to develop a technique to generate an individual by producing hybrid cells with different nucleus and cytoplasm by means of nuclear transplantation in tissue culture cells, and by transplanting the nucleus of hybrid cells obtained by cell fusion.

When this technique is developed, it will be possible to introduce characteristics from a species that could not be mated. For example, it is conceivable to provide thermophilic or homing characteristics to other fish by using the ova of rainbow trout.

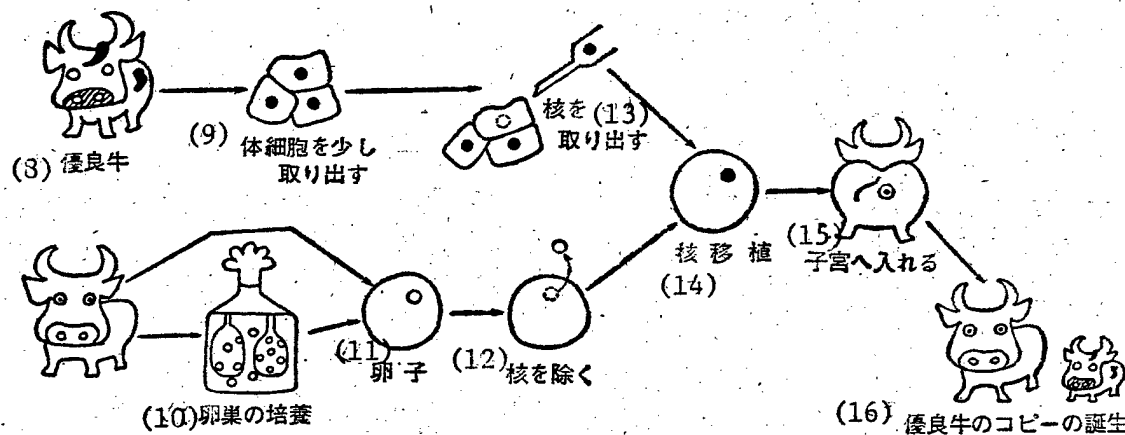
This research will be shared by the Sericultural Experiment Station and the Cultured Pearl Institute of MAFF, and in part commissioned to the Group of Biological Sciences, Tsukuba University.

The goals to be achieved through these research and development projects are: 1) to enable cloning and mass production of superior lines by exchanging the nuclei of livestock ova and other cellular nuclei, whereby the breeding time is greatly shortened; and 2) to develop a technique to produce new varieties and organisms by exchanging the nuclei of fishes or insects' ova and fused cells.

Breeding of Crop Plants by Cell Fusion (Process for producing eggplants resistant to bacterial wilt disease)



(7) 核移植による優良牛コピーができるまで



Key:

- (1) Eggplant (good quality, but susceptible to bacterial wilt disease)
- (2) Tolubum [phonetic]-resistant to bacterial wilt disease, but the fruit is not edible
- (3) graft onto tolubum [phonetic] (currently used method of prevention)
- (4) remove cell wall
- (5) cell fusion
- (6) eggplant resistant to wilt disease is produced
- (7) process for producing copies of superior cows by nuclear transplantation
- (8) superior cow
- (9) a few somatic cells are taken out
- (10) ovary culture
- (11) ova
- (12) remove nucleus
- (13) take out nucleus
- (14) nuclear transplantation
- (15) insert into the uterus
- (16) birth of a superior cow clone

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CSO: 4106/85

## SCIENCE AND TECHNOLOGY

### BRIEFS

ROCKET DEVELOPMENT--Tokyo, 3 Jun (KYODO)--The Science and Technology Agency and the National Space Development Agency will jointly develop a large-sized rocket capable of launching 1-ton geostationary satellites by around 1990, sources at the agencies said Thursday. The plan for the rocket's development, including choice of design, is expected to be finalized early next week, according to the sources. The development agency is now working on another rocket known as the "H1A," capable of launching a 550-kilogram geostationary satellite. The first H1A is scheduled to be launched in 1987. However, the Nippon Telegraph and Telephone Public Corporation earlier this year made public its plan to launch a 1-ton geostationary satellite around 1988 or 1989 and a 4-ton geostationary satellite in the period 1985-1994, both with the use of the U.S. space shuttle. In response to the corporation's plan, the two agencies decided to develop the large-sized rocket to protect their position in space development, the sources said. [Text] [OW031203 Tokyo KYODO in English 1130 GMT 3 Jun 82]

CSO: 4120/291

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